What is momentum?

- More mass or speed, more momentum
- object's wanting to stay in motion
- force required to stop a moving obj.
- it is a vector
- continuation of force
- Something to get object moving
- increasing force in continuous direction
- kinetic energy of an object
- causes inertia

Momentum:

- intrinsic property of any object
  - ↳ base characteristic
- $\bar{p} = m\bar{v}$
  - ↳ momentum; it's a vector
- units: $kg \cdot m/s$
- Relationship between force and momentum

$$\Sigma \bar{F} = m\bar{a} \qquad \bar{a} = \frac{\Delta \bar{v}}{\Delta t}$$

$$\Sigma \bar{F} = m\frac{\Delta \bar{v}}{\Delta t}$$

$$\Sigma \bar{F} = \frac{m\Delta \bar{v}}{\Delta t}$$

$$\Sigma \bar{F} = \frac{\Delta \bar{p}}{\Delta t}$$

$$\Delta \bar{p} = \Sigma \bar{F}\,\Delta t$$

↳ Impulse $\Rightarrow \bar{J}$

Impulse: $\bar{J} \equiv \Sigma \bar{F}\,\Delta t$

- Impulse - Momentum theorem: $\bar{J} = \Delta \bar{p}$

$$\Sigma \bar{F}\,\Delta t = \Delta \bar{p}$$

$$\Sigma \bar{F}\,\Delta t = m\,\Delta \bar{v}$$

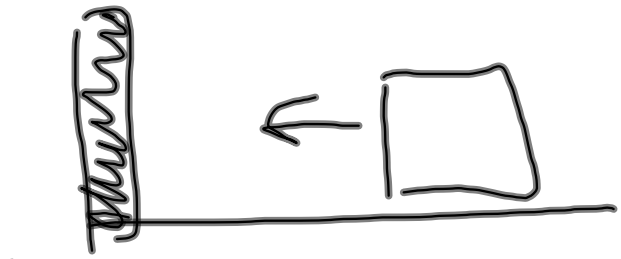
$$\Sigma \bar{F}\,(t_f - t_i) = m(\bar{v}_f - \bar{v}_i)$$

What are implications of the impulse-momentum theorem?

- greater mass/velocity gives greater momentum
- greater momentum, greater impact force
- mass goes same direction until hitting something
- small time gives great force
- long time will have small force

- Practical applications:
  - Airbags
  - Driving heavier loads
  - Driving faster
  - Skimboarding

A 1400 kg car moving westward with a velocity of 15 m/s collides with a utility pole and is brought to rest in 0.30 s. Find the force exerted on the car during the collision.



$+\leftarrow$

$F = ?$

$t = 0.30\ s$

$m = 1400\ kg$

$v_i = +15\ m/s$

$v_f = 0\ m/s$

$$\Sigma \bar{F} \Delta t = m \Delta \bar{v}$$

$$F = \frac{m(v_f - v_i)}{\Delta t}$$

$$= \frac{(1400\ kg)(0\ m/s - 15\ m/s)}{0.30\ s}$$

$$= -70\,000\ N$$